

Unbalanced Supergradient Flow: Its Role in Organizing Severe Turbulence in Both Convective and Clear Air Case Studies

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What is Supergradient Flow? (Flow Which Exceeds Gradient Wind Balance)

$$(V^{**2}/R) > (PGF + FV)$$

V=Horizontal Wind Velocity

R=Radius of Flow Curvature

PGF=Horizontal Pressure

Gradient Force

FV=Horizontal Coriolis Force

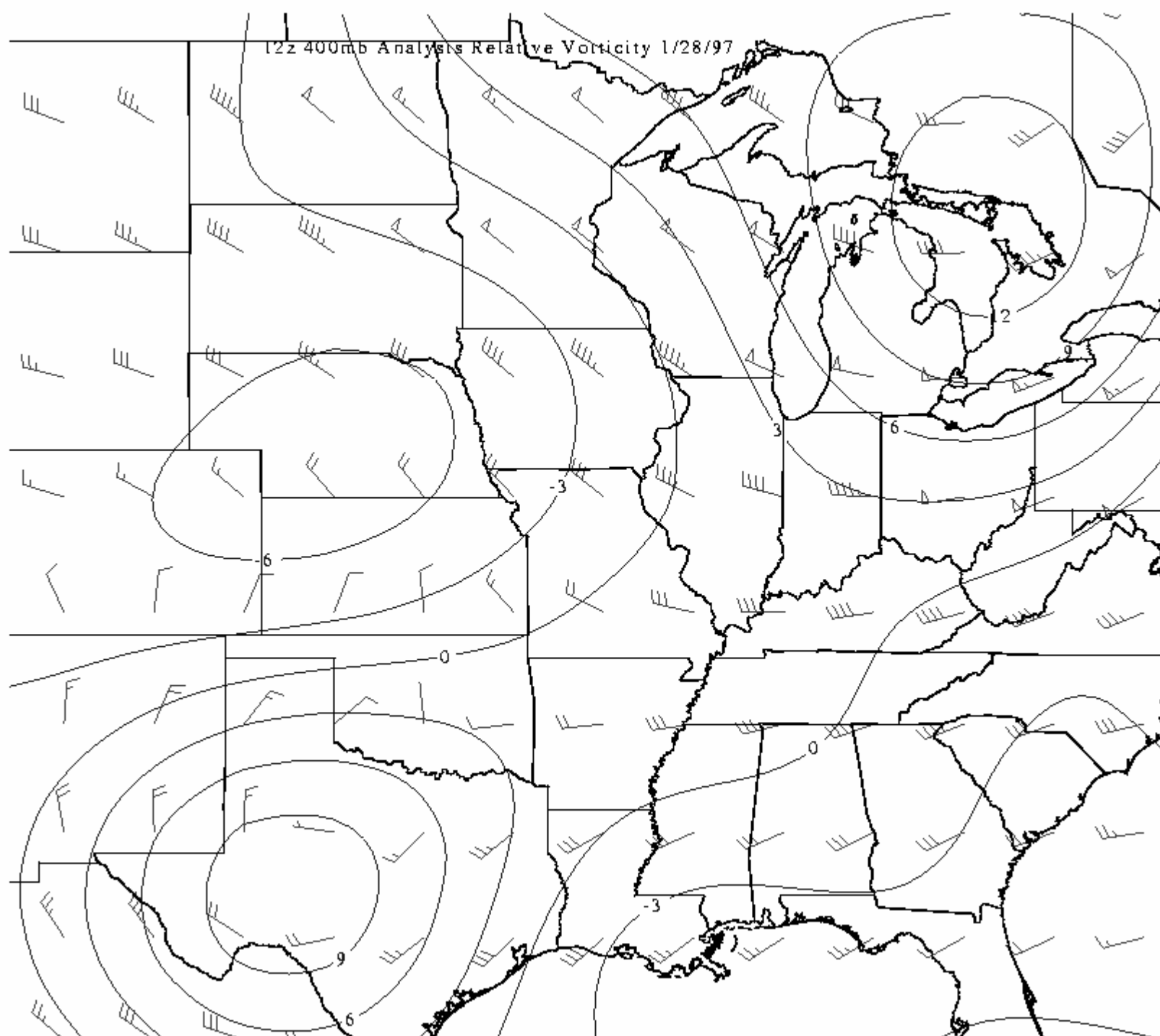
Presentation Overview

- 44 Case Synoptic Observational Signal
- Clear/Convective Accident Synoptic Signal
- Simulated Mesoscale Supergradient Flow
- Mass Perturbation/Supergradient Imbalance
- Flanking/Trailing Microvortex Genesis
- Single Characterization/Forecasting Index

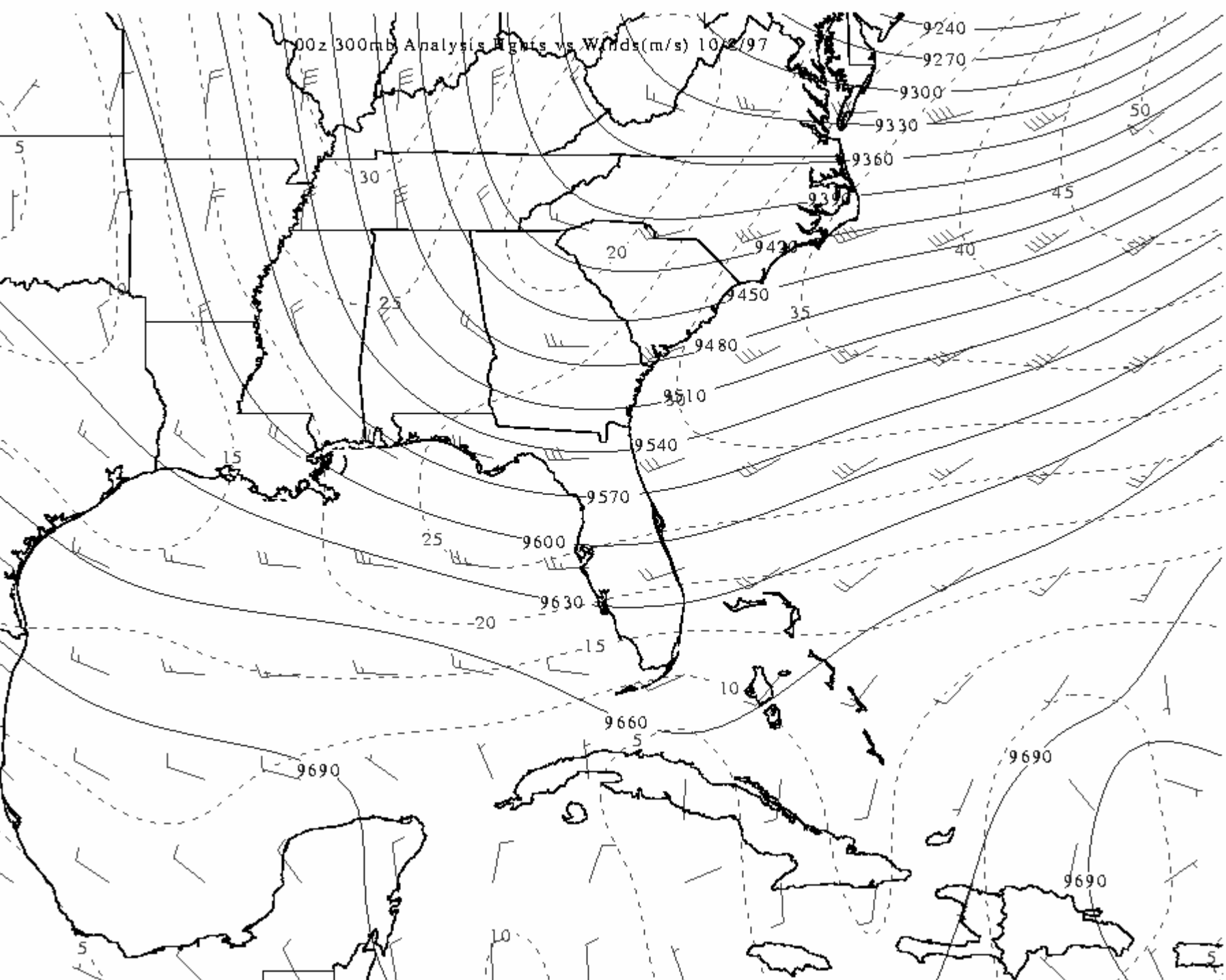
Primary Observed Synoptic Signals in the 44 Case Studies

- 1. Immediate Upstream Curvature (98%)
- 2. Convection < 100 km Away (86%)
- 3. Upward Vertical Motion (82%)
- 4. Absolute Vorticity < 10^{-4} s^{-1} (80%)
- 5. Jet Entrance Region (77%)
- Indicates: Horizontally Changing Curvature in Proximity to a MASS Perturbation in the Entrance Region of 1 or More Jet Streams

12z 400mb Analysis Relative Vorticity 1/28/97



00z 300mb Analysis Heights vs Winds(m/s) 10/2/97



MASS Model Numerical Simulations

CGI Clear Air

12 km Hydrostatic

6 km Hydrostatic

2 km Nonhydrostatic

Enhanced Vertical

500m

Nonhydrostatic

125m

Nonhydrostatic

60m Nonhydrostatic

CTY Convective

18 km Hydrostatic

6 km Hydrostatic

2 km Nonhydrostatic

Bogus Raob RH

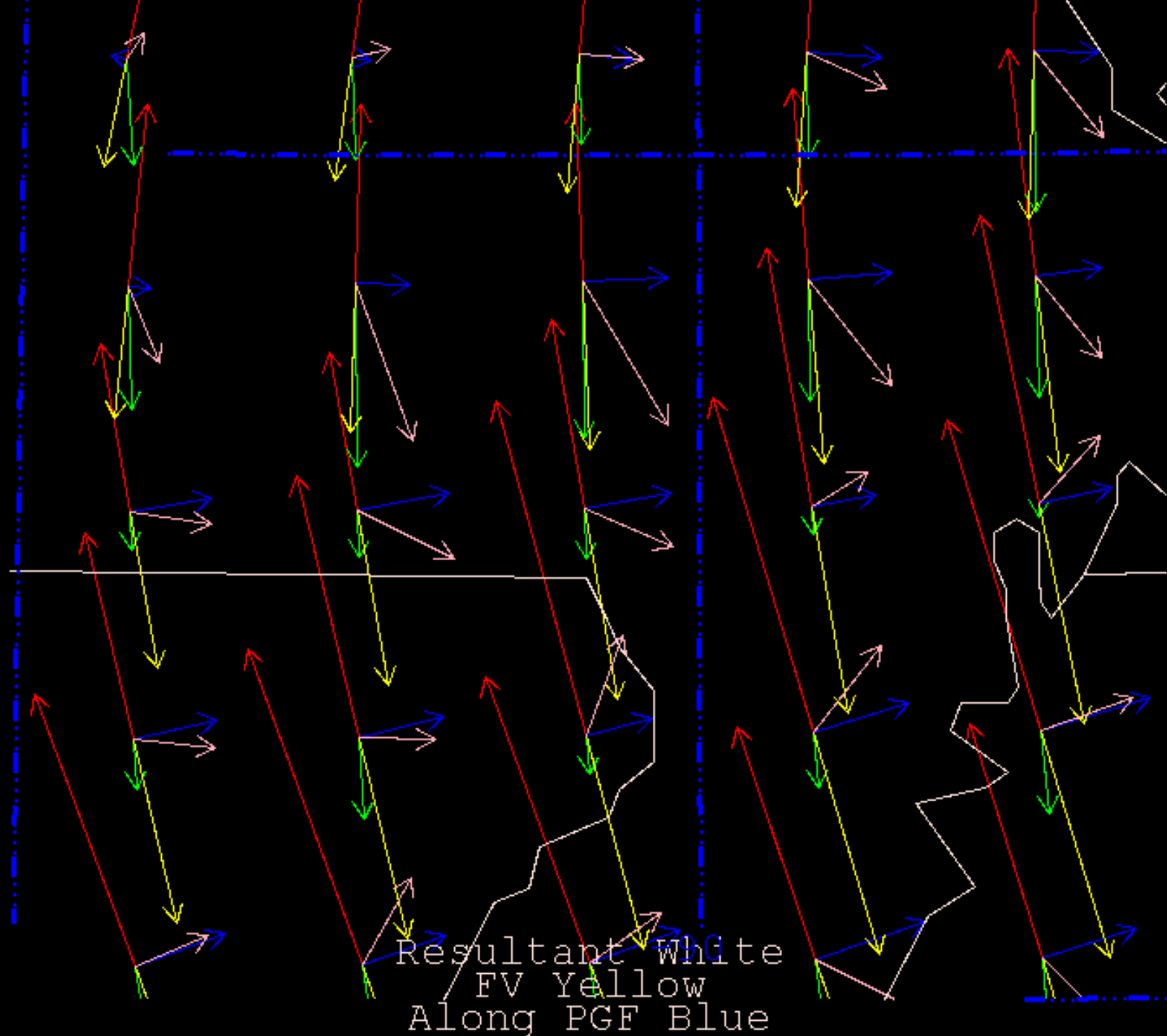
500m

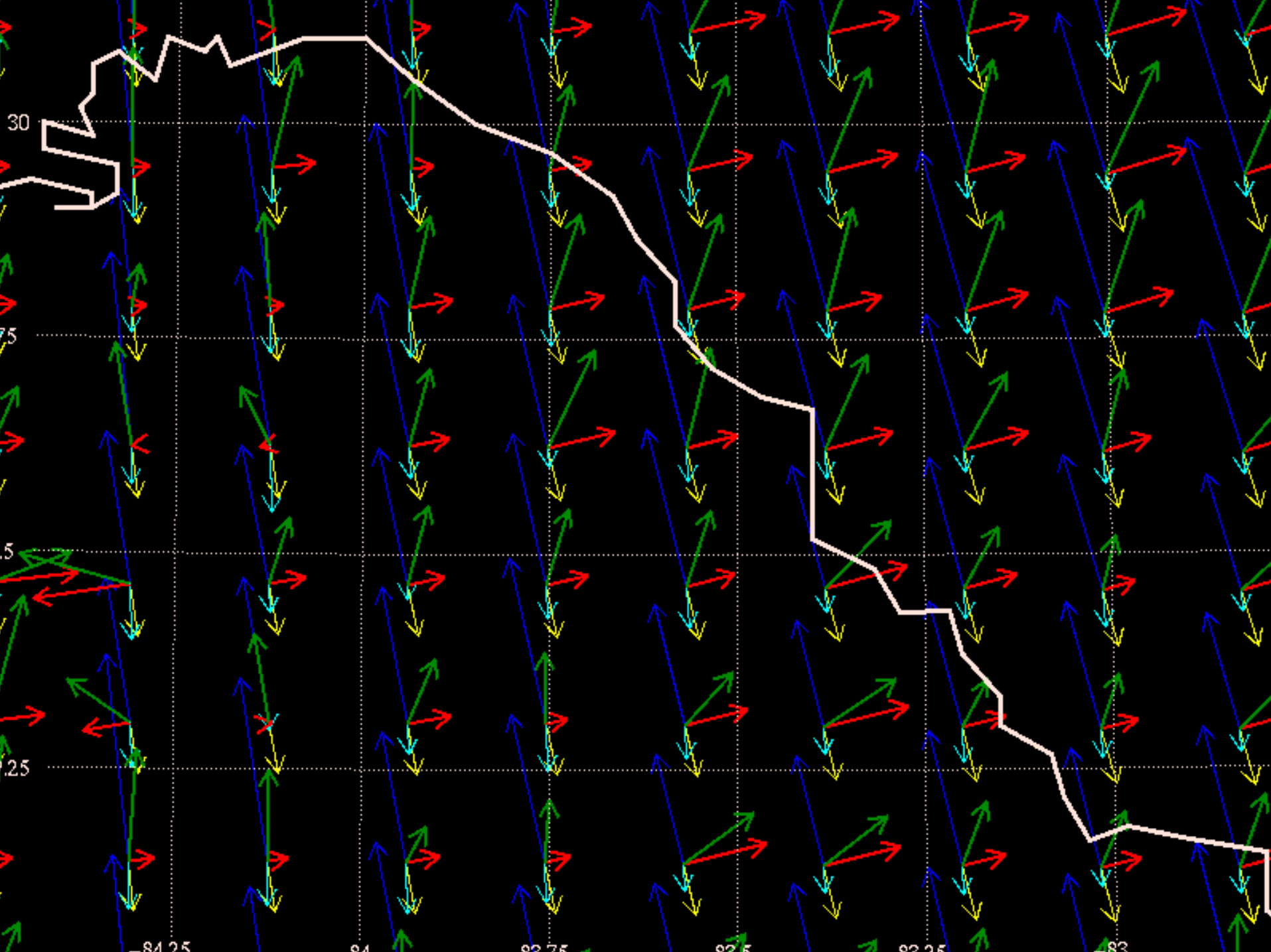
Nonhydrostatic

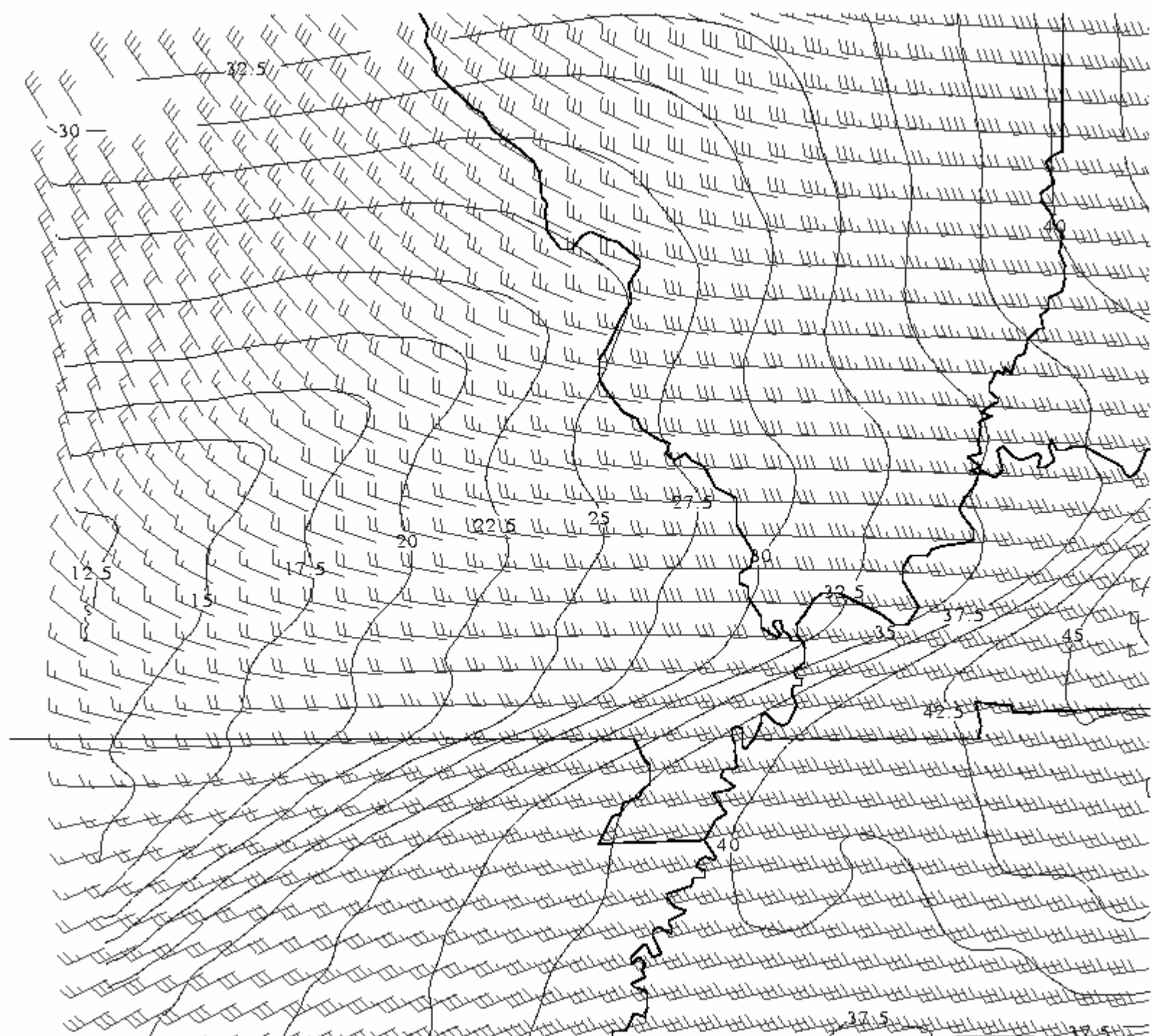
125m

Nonhydrostatic

60m Nonhydrostatic

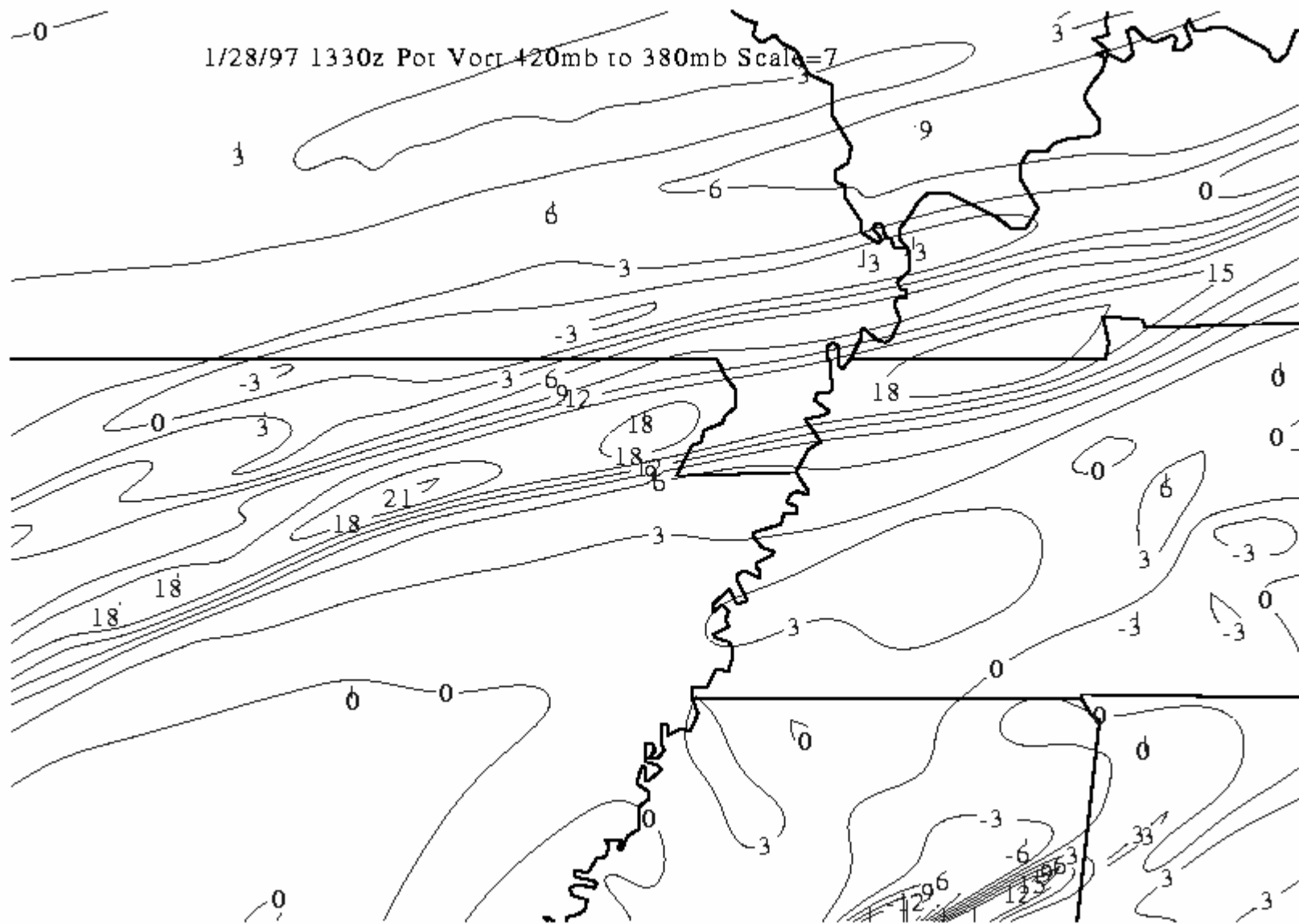


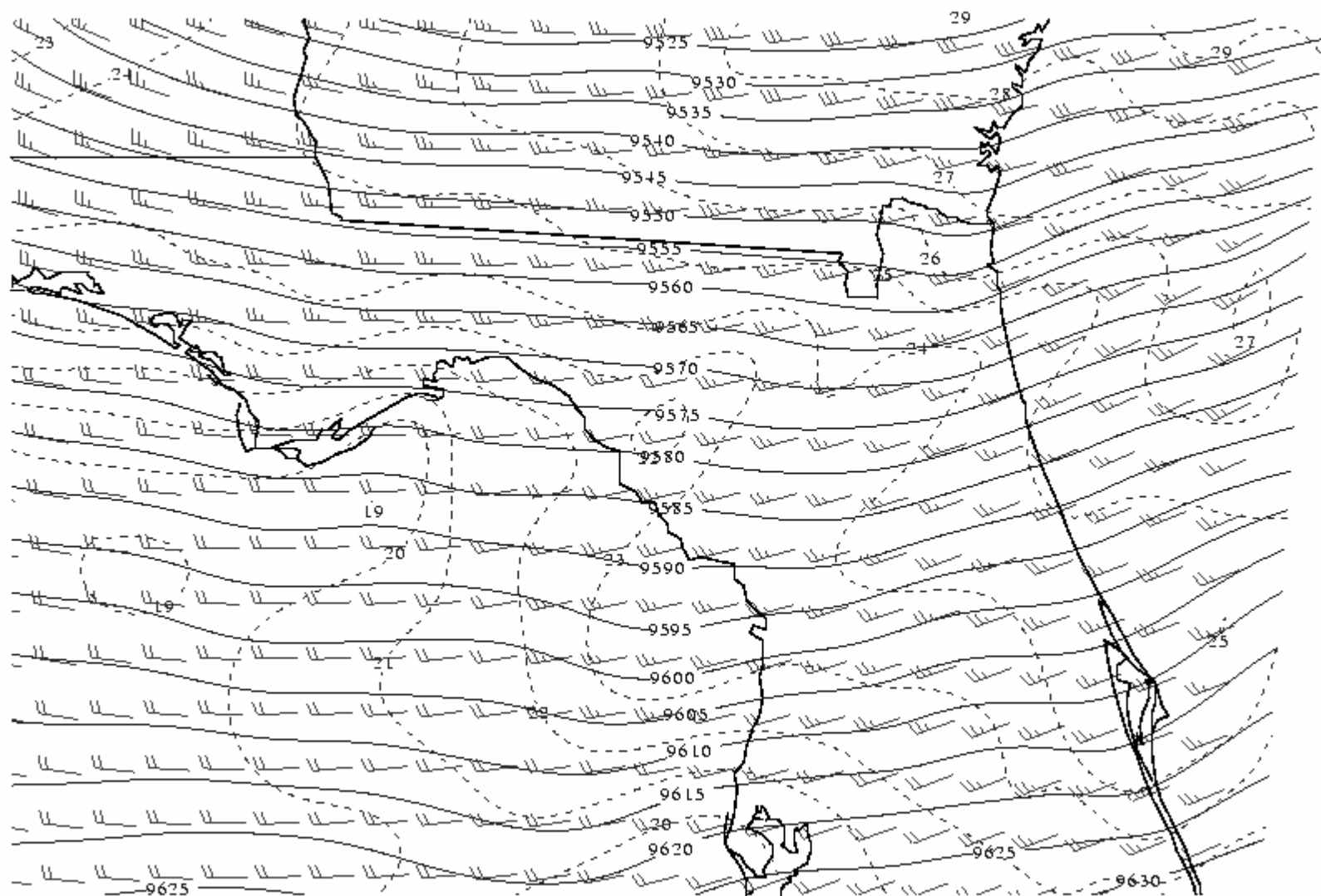




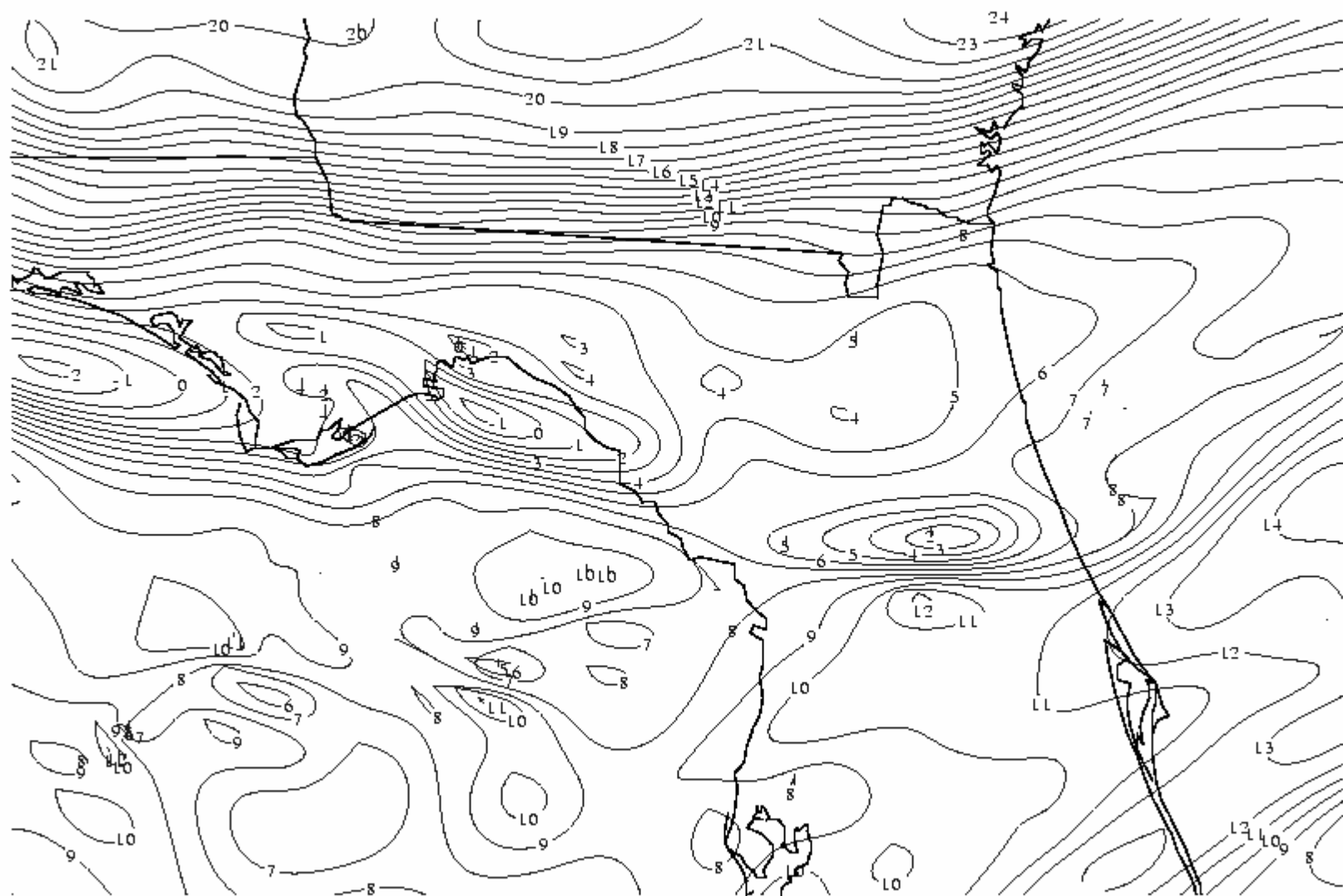
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1/28/97 1330z Pot Vort 420mb to 380mb Scale=7

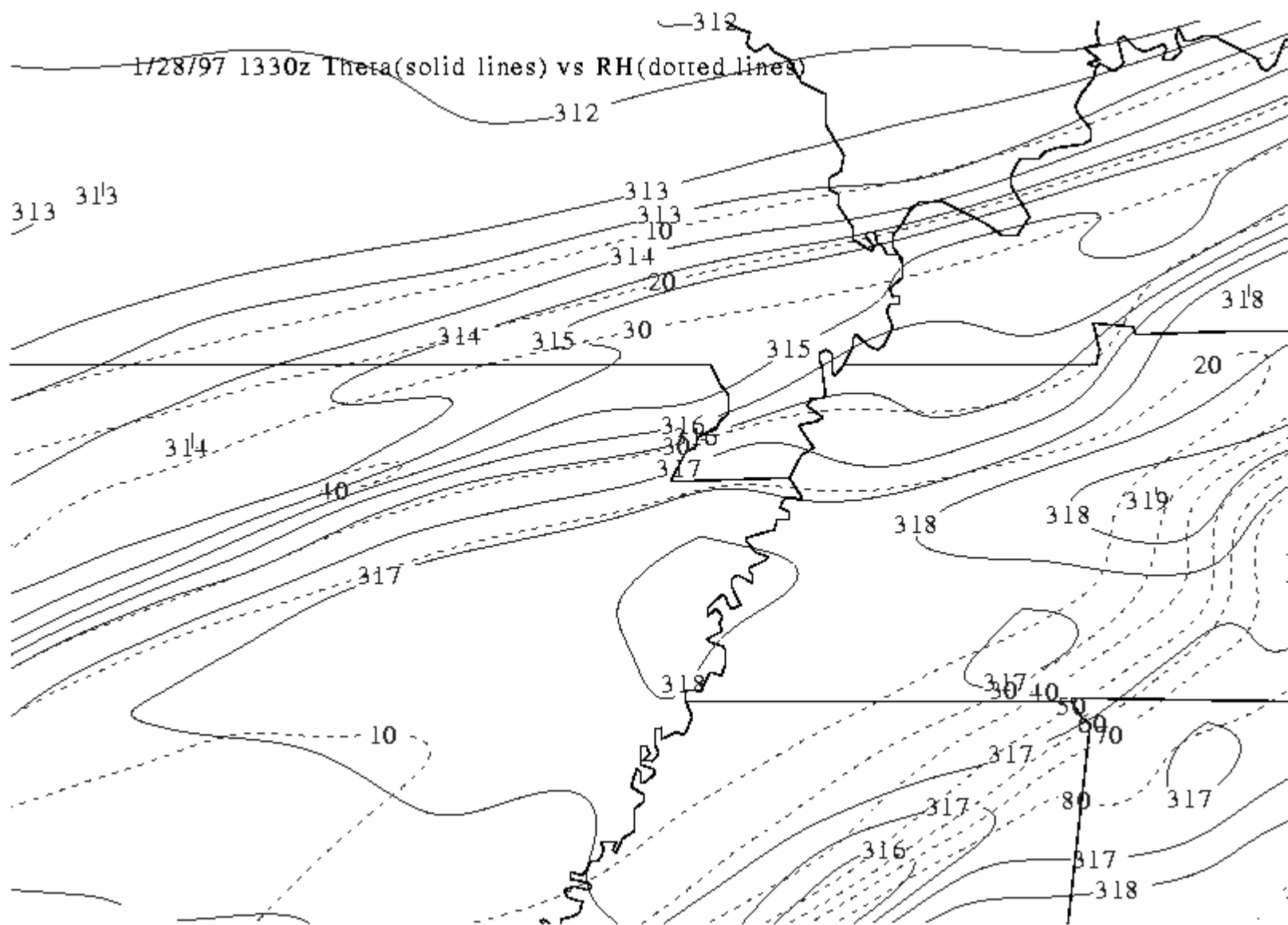


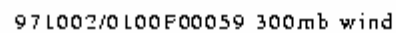


8/29/96 300 mb Heights vs Winds

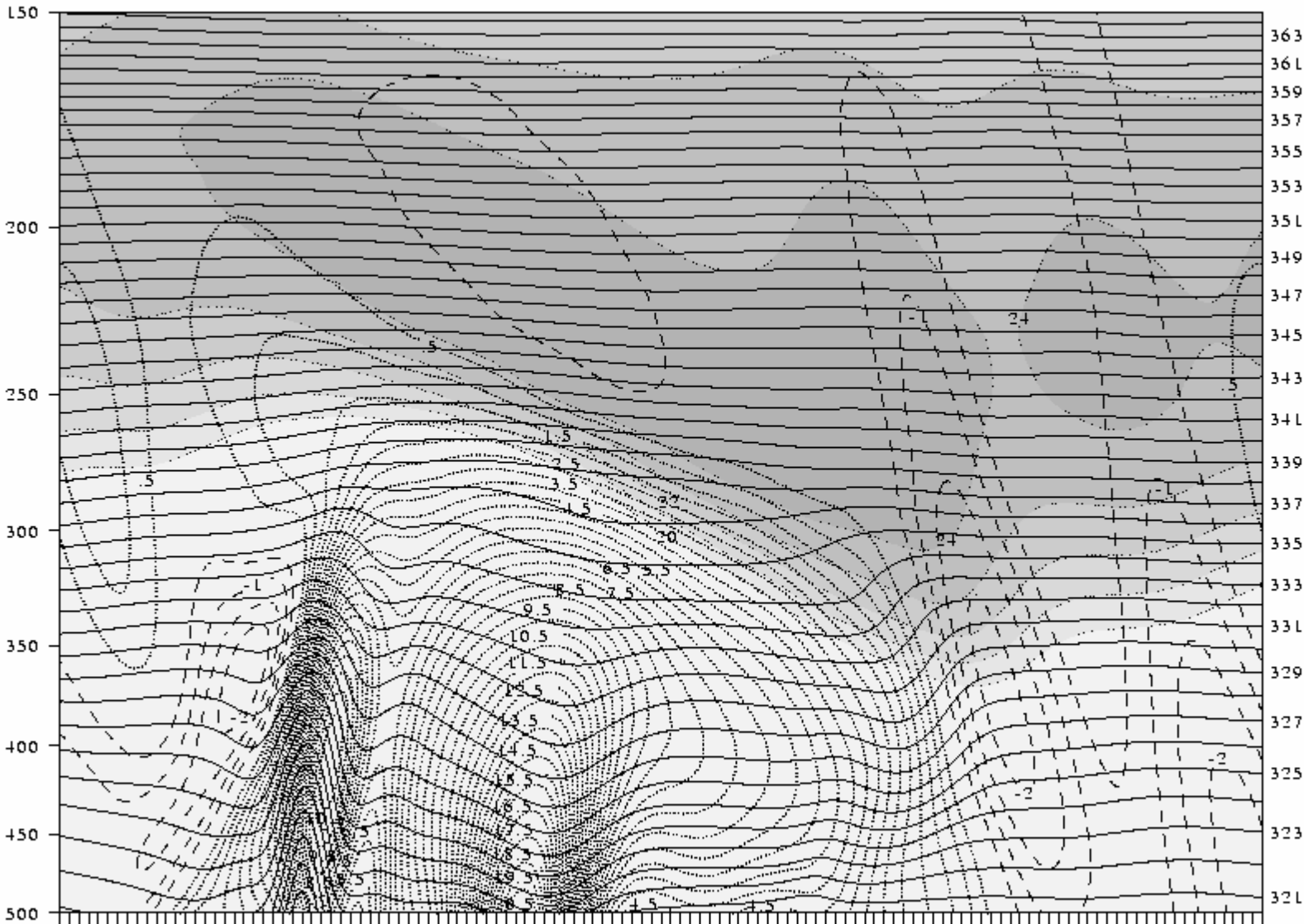


CTY Case PVOR with Theta, 0z 10/2/97





971002/0140F00018 29.75;-84>29.75;-83.8 theta, wind, W



29.75;-84

Single Characterization/Forecast Index

- Cross Product of $\text{DEL}(\text{M})$ and $\text{DEL}(\text{ZETA})$
- $\text{DEL}(\text{M}) = \text{Gradient}(\text{CpT} + \text{GZ})$
- $\text{DEL}(\text{ZETA}) = \text{Gradient}(\text{DV}/\text{DX} - \text{DU}/\text{DY})$
- $\text{PGF} \times \text{DEL}(\text{ZETA})$ on Isentrope
- PGF Vector and Vortex Tube Intersect

Summary of the Organization of the Turbulence Environment

- Jet Streak Entrance Regions Merge In the Presence of Curved Flow
- Deformation Zone Forms As Momentum Converges and Centrifugal Force Increases
- Cross-Stream (Z) Vortices are Produced in Supergradient Flow Confluence Zone
- MASS Perturbation (Moist Convection /Frontogenesis) Modifies Along-Flow PGF
- (Y) Vortex Converges (Z) Vorticity=Hazard